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EPA Superfund
Record of Decision:

GEIGY CHEMICAL CORP. (ABERDEEN PLANT)
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ABERDEEN, NC
08/27/1992

RECORD OF DECISION SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

GEIGY CHEMICAL CORPORATION SITE
ABERDEEN, MOORE COUNTY
NORTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

DECLARATION
FOR
THE RECORD OF DECISION

SITE NAME AND LOCATION

Geigy Chemical Corporation
Aberdeen, Moore County, North Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Geigy Chemical Corporation Superfund Site in Moore County, North Carolina, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Contingency Plan. This decision is based on the administrative record file for this Site.

The State of North Carolina concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedy addresses the principle threat posed by this Site. The major threat is the contaminated groundwater emanating from beneath the Site. This remedial action will also address soil contamination.

The major components of the selected remedy include:

GROUNDWATER

Extraction of groundwater across the Site in the upper aquifer and the second uppermost aquifer that is contaminated above Maximum Contaminant Levels or the North Carolina Groundwater Standards, whichever are more protective;

On-site treatment of extracted groundwater via carbon adsorption to remove contaminants;

Discharge of treated groundwater to the local POTW or an infiltration gallery. The discharge location will be determined in the Remedial Design; and

Continued analytical monitoring for contaminants in groundwater.

SOIL

Demolition of former warehouse foundation; Disposal at a municipal or secure landfill;

Excavation of the top foot of on-site soils contaminated above the performance standards;

TCLP testing of the stockpile of contaminated soil to determine final disposition;

Off-site incineration of contaminated soils that fail the TCLP test;

Off-site disposal in an approved hazardous waste landfill of contaminated soils that pass the TCLP test;

Backfilling, grading and revegetation of excavated area;

ADDITIONAL SAMPLING AND MONITORING

Additional sampling and analyses of the second uppermost aquifer to determine the extent of pesticide contamination, and to determine if the trichloroethylene (TCE) found in two wells is site-related. Until it is proven that the TCE is not site-related, it will be assumed that the TCE is site-related and thus, it will be included as a contaminant of concern.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Since this remedy may result in hazardous substances remaining onsite above health based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE

LIST OF TABLES

TABLE

DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

A. Introduction

The Geigy Chemical Corporation Site (Geigy Site) is located just east of the corporate city limits of Aberdeen, North Carolina on Highway 211 in southeastern Moore County (Figure 1). The Site was operated as a pesticide blending and formulation facility from approximately 1947 to 1967 and was operated by retail distributors of agricultural chemicals from 1968 to 1989.

B. Site Description

The Geigy Site is an approximately one-acre parcel located on the Aberdeen and Rockfish Railroad right-of-way. The property is in the form of an elongated triangle between Highway 211 and the railroad, with the highway and railroad intersecting at the apex of the triangle.

The Site is currently vacant and consists of partial concrete foundations from two former warehouses, an office building, and a concrete tank pad (Figure 2).

At the east end of the former warehouse buildings is an on-site water supply well. The well water was probably used for process operations, lavoratories, showers, and on-site drinking water.

C. Topography

The Site is in the Sandhills physiographic province, characterized by rolling hill underlain by well-drained, unconsolidated sands. Site elevations range from approximately 460 to 480 feet above mean sea level (MSL). The Site is essentially flat.

D. Geology

Generally, the geology under the Site consists of unconsolidated sedimentary rocks which were deposited on top of crystalline basement rocks. The thickness of the sedimentary rocks in the Aberdeen area is approximately 200 to 250 feet. The surface geology consists of Coastal Plain sediments, crystalline rocks of the Piedmont province, and Triassic basin rocks.

Site soils are of the Candor series and are deep, excessively drained sandy soils (e.g., sand, silty sand, loamy sand, sandy loam).

E. Surface Water

There is no surface water at the Site. Drainage ditches at the Site are dry except during storm events. Surface water runoff during storms is rapidly absorbed into the well-drained soils in the vicinity of the Site.

F. Hydrogeology

Three aquifers underlie the Site: the shallow (uppermost), Black Creek (second uppermost), and Upper Cape Fear (third uppermost) aquifer.

The uppermost aquifer (shallow aquifer) receives rainfall infiltration. Approximate depth to groundwater in the uppermost aquifer at the Site is 35 to 45 feet. Saturated thickness at and near the Site ranges from one to 18 feet with an average saturated thickness and hydraulic conductivity beneath the Site of 12 and 2.8 feet/day, respectively.

Potentiometric data from the shallow monitoring wells indicate groundwater flow from the eastern and western portions of the Site meet in an elongated zone of convergence. East of the convergence zone, groundwater flows west and northwest and west of the convergence zone, groundwater flow is predominantly to the east-southeast.

The Black Creek confining unit is between the surficial aquifer and the second uppermost aquifer.

Average thickness and hydraulic conductivity of the second uppermost aquifer are 40 feet and 28 feet/day, respectively. This aquifer serves as the primary source of potable groundwater in the Aberdeen area. Groundwater flow in the second uppermost aquifer is generally northwesterly.

The Upper Cape Fear confining unit (approximately 60 feet thick) is over the Upper Cape Fear aquifer. In the Aberdeen area, the third uppermost aquifer ranges from 10 to 20 feet thick and directly overlies the crystalline bedrock. Groundwater flow in this aquifer is generally to the northwest.

G. Meteorology

Average daily maximum temperature is 90 degrees F. in July and average daily minimum is 30 degrees F. in January. Average annual precipitation is 48 inches. Precipitation is fairly uniform year-round, ranging from three to five inches per month.

H. Demography and Land Use

The Site is bordered to the north by Route 211, to the south by a wooded area and to the west by Route 211 and the Aberdeen and Rockfish railroad. A residential property borders the east. A farm is located to the southeast of the site while the property immediately north on the opposite side of Route 211 is used for commercial purposes. A housing development is located 1/4 mile to the northwest of the site.

Moore County occupies a total area of 672 square miles and has an estimated population of 59,013 (1990 census). Approximately 2700 people live in Aberdeen. Within 0 - 1 mile of the site, there are 355 families and a total of 1,208 people with a median age of 34 years. Approximately 132 people or 11% of the population within the 0 - 1 mile radius are between the ages of 7 to 13 years.

I. Utilities

Electricity, telephone, natural gas, and city water are available at the Site. Moore County sewerage connection is not available at the Site but is available within a half of a mile.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Site History

The Geigy Site has been leased and operated by various companies since approximately 1947. From approximately 1947 to 1967, the Site was leased by several companies for pesticide formulation and retail sales. Since 1968, the Site has been used by retail distributors of agriculturalchemicals, mainly fertilizers. The most recent occupant, Lebanon Chemical Corporation, operated a farm service center on the Site for retail distribution of agricultural pesticides and fertilizers. The Site is currently unoccupied; however, the Aberdeen and Rockfish Railroad which traverses the southern portion of the Site is still active.

Known operators at the Site and approximate dates of operation are as follows:

- White & Peele (1947-1948)
- Blue Fertilizer (1948-1949)
- Geigy Chemical Corporation (now Ciba-Geigy) (1949-1955)
- Olin-Matheison Corporation (now Olin Corp) (1956-1967)
- Columbia Nitrogen Corporation (1968)
- Kaiser Aluminum & Chemical Corporation (1969-1984)
- Lebanon Chemical Corporation (now Kaiser-Estech Corp) (1985-1989)

Agricultural fertilizers, both liquid and dry, in bulk and bagged form, have been distributed from the facility at various times during the operating history. Micronutrients, such as copper and zinc, were added to fertilizers in small quantities (i.e. 0.05% to 0.3%) to increase the quality and yield of crops. The pesticides DDT, toxaphene, and BHC were known to have been formulated on-site. Technical grade DDT, toxaphene, and BHC were shipped in bags or barrels to Aberdeen. The technical grade pesticide was blended with clay or other inert materials to form a usable product and repackaged for sale to local cotton and tobacco growing markets. Pesticides were not manufactured at the Site, but rather only formulated (i.e., blended) into a product suitable for local consumer use.

B. PREVIOUS INVESTIGATIONS

An EPA Site Investigation (SI) was conducted in March 1988. The purpose of the SI was to collect soil and water samples to support the Hazard Ranking System (HRS) evaluation.

Isomers of BHC were detected in five groundwater samples from offsite locations: two private wells and three of the municipal wells. Lead was detected in concentrations exceeding the drinking water standards in two private wells. Lead was not detected in the on-site groundwater sample.

The Site was regraded by the railroad after this investigation, therefore the soil sample locations were not relied upon for future work.

C. Enforcement Activities

There is no information of any past enforcement actions or violation citings at the Site. In addition, no known inspections by the North Carolina Department of Environmental Management (DEM) or the Department of Natural Resources (DNR) occurred.

The Geigy Chemical Corporation Site was proposed for inclusion on the National Priorities List (NPL) in June 1988 and became final on October 4, 1989.

In March 1988, EPA sent notice letters to the following companies:

1. Ciba-Geigy Corp
2. Olin Corp
3. Kaiser Aluminum & Chemical Corp
4. Lebanon Chemical Corp
5. Aberdeen and Rockfish Railroad
6. Columbia Nitrogen Corporation

The letters requested that the PRPs conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. The notice letters also informed the PRPs of their potential liability for past costs. On December 16, 1988, EPA entered into an Administrative Order on Consent (AOC) wherein three of the PRPs, Ciba Geigy, Olin, and Kaiser, agreed to perform the RI/FS.

The AOC was amended on January 23, 1991 to include the removal and proper disposal of contaminated soils containing toxaphene greater than500 mg/kg and/or lindane at 100 mg/kg.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Pursuant to CERCLA S 113(K)(2)(B)(i-v) and S 117, the RI/FS Report and the Proposed Plan for the Geigy Site were released to the public for comment on March 26, 1992. These documents were made available to the public in the administrative record located in an information repository maintained at the EPA Docket Room in Region IV and at the Aberdeen Town Hall in Aberdeen, North Carolina. The notice of availability for these documents was published in the Pilot Newspaper (Southern Pines) and in the Moore County Citizen News (Aberdeen) on March 26, 1992. A public comment period on the documents was held from March 26, 1992 to April 24, 1992. Due to several requests, the public comment period was extended to May 25, 1992. Notice of this extension was placed in both newspapers on April 23, 1992. A copy of the notice was mailed to the public. In addition, a public meeting was held on March 31, 1992. At this meeting, representatives from EPA answered questions about problems at the site and the remedial alternatives under consideration.

Other community relations activities included:

- Issuance of a Fact Sheet on the RI/FS process in May 1990.

- An availability session to address citizen concerns in June 1990.

- Issuance of a Fact Sheet on the RI results in December 1991.

- Issuance of a Fact Sheet on the Proposed Plan in March 1992.

IV. SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

The intent of this remedial action presented in this ROD is to reduce future risks at this Site. This remedial action will remove the threat posed by contamination at the Site. This is the only ROD contemplated for the Site. No other operable units have been identified at this Site.

V. SUMMARY OF SITE CHARACTERISTICS

The RI at the Geigy Site included the characterization of groundwater, soil and sediment contamination. Surface water samples were not collected because there are no nearby surface water bodies.

In addition, two removals (in three phases) were conducted during the RI. Results of these removals will be summarized below.

A. Groundwater Investigation

The groundwater investigation was conducted in two phases. In the first phase, ten groundwater monitoring wells were installed: six (MW-1S through MW-6S) in the shallow aquifer; three (MW-1D, MW-4D, and MW-6D) in the intermediate aquifer; and one in the deep aquifer. In addition, the water supply well was also included in the investigation (Figure 3).

The sampling was conducted in November 1990. Analytical parameters included field parameters (pH, temperature, specific conductance), Target Compound List (TCL) volatiles, semivolatiles, and pesticides and Target Analyte List (TAL) metals.

The results of the volatile and semi-volatile analyses is shown in Table 1, Appendix A. Acetone was found in three wells, but is believed to be a laboratory contaminant because acetone was also found in the blank samples. Xylene and bis(2-ethylhexyl)phthalate were each found in only one well at 4J ug/l and 7J ug/l respectively. The compound 1,2,4-trichlorobenzene was found in two wells, MW-5S and MW-6S, at 4J ug/l and 5J ug/l respectively. Trichloroethene was found in two deep wells, MW-4D and MW-6D, at 200 ug/l and 11 ug/l respectively.

The pesticide results are shown in Table 2, Appendix A. As indicated, pesticides were detected in all the shallow wells except MW-1S, which is a background well. Pesticides were not detected in the intermediate or deep wells. Gamma-BHC (lindane) was the most prevalent, ranging in concentration from 0.4 ug/l to 30 ug/l. The Maximum Contaminant Level (MCL) for gamma-BHC is 0.2 ug/l. Toxaphene was found in three wells in concentrations up to 10 ug/l. The MCL for toxaphene is 3 ug/l.

Results of the metal analyses are summarized in Table 3, Appendix A. The secondary drinking water standard for iron (300 ug/l) was exceeded in six wells including both upgradient wells (MW-1S and MW-1D). Copper was detected in the water supply well at a concentration of 1,180 ug/l which is above the secondary drinking water standard of 1000 ug/l. The MCL for lead of 50 ug/l was exceeded in the water supply well at 51B ug/l. None of the other wells contained lead above the MCL or the CERCLA cleanup level of 15 ug/l.

Based on the results of the first phase of groundwater sampling, the investigation expanded laterally. Six monitoring wells were installed in areas downgradient of the existing monitoring well system in the shallow aquifer (MW-7S through MW-10S, MW-12S and MW-13S). In addition, three monitoring wells were installed in the intermediate aquifer (MW-11D, MW-14D, and MW15D) (Figure 4). Two of the intermediate wells, MW-14D and MW-15D, were installed to try to determine if the trichloroethene found in wells MW-4D and MW-6D, was coming from an upgradient source. In addition, two private wells were also sampled. Monitor wells MW-7S through MW-10S, MW-12S, MW-13S, MW-11D, MW-14D, and MW-15D were analyzed for TCL pesticides and volatile organics. Wells MW1D, MW-4D, PZ-1, and the two private wells, Allred and PMP, were analyzed for TCL volatiles only.

The results of the TCL volatile analyses is presented in Table 4, Appendix A. The compounds 2-butanone, 1,1,1-trichloroethane, 4-methyl- 2pentanone, and toluene were found in only one well, the PMP well, at concentrations below MCLs. Trichloroethene was found in the two private wells as well as monitoring wells MW-4D, MW-6D and PZ-1. The two upgradient deep wells, MW-14D and MW-15D, did not contain any trichloroethene.

The TCL pesticide results are shown in Table 5, Appendix A. Pesticides were found in two wells, MW-10S and MW-11D.

B. Initial Removal Activity

The initial site reconnaissance in January 1989 identified obvious areas of pesticide contamination in surface soils near the warehouse loading doors and railroad dock. The removal was conducted in two phases, one in February 1989 and the other in October 1989 (Figure 5).

Visually contaminated soils were sent to a landfill in South Carolina for disposal as hazardous waste. In addition, railroad ties were removed from the Area C spur track and were disposed with the soils. A total of 462 tons of waste were disposed. On March 1, 1989, a ban was issued by the Governor of South Carolina which precluded the disposal of any hazardous waste from North Carolina in South Carolina. Once the ban was lifted, the remainder of visually contaminated soils were removed. In October 1989, 227 additional tons of contaminated soils were shipped to South Carolina.

C. Soil Investigation

The soils investigation was conducted in four phases. Phase 1 provided a definition of potential Site-specific parameters for soils (TCL pesticides, copper, lead, zinc); Phase 2 defined the horizontal extent of contamination; Phase 3 delineated the vertical extent of contamination; and Phase 4 provided additional information to complete the data set.

The Phase 1 soil sampling locations are shown on Figure 6. The volatile and semi-volatile results are given in Table 6, Appendix A. Acetone was found in all the samples, but was also found in the associated blank. Benzoic Acid was found in three samples ranging in concentrations from 360J ug/kg to 3600J ug/kg. The metals results are shown in Table 7, Appendix A. Most of the metal concentrations were within the range of the concentrations detected in the background sample (SS-04).

Pesticides were detected in all the samples. Total DDT was the most prevalent compound found. Toxaphene was found in three samples, with concentrations ranging up to 400,000 ug/kg (Table 8, Appendix A).

For the Phase 2 soils investigation, a forty-foot grid was established over the Site as shown in Figure 7. The samples were analyzed for TCL pesticides, along with copper, lead, and zinc. Analytical results are given in Table 9, Appendix A. Toxaphene and DDT were the most prevalent compounds found during this phase.

In addition, two background soil samples, SS-121 and SS-122, were obtained north and east of the Site. Analytical results are given in Table 10, Appendix A.

For Phase 3, the analytical results were reviewed to determine which sample locations contained significant concentrations of Site specific parameters. The term significant was defined as a soil concentration level of 10 mg/kg or greater total BHC, total DDT, or toxaphene. Sample grid locations exhibiting concentrations between 10 mg/kg and 100 mg/kg were resampled at two-foot and five-foot depth intervals. Sample grid locations with concentrations greater than 100 mg/kg were sampled at two, five, and ten-foot depth intervals.

Table 11, Appendix A shows the analytical results for the sample locations that contained pesticides. Twenty samples at the two-foot depth contained pesticide constituents. Of those, only three samples contained a significant total pesticide concentration; SS-51-2 (50 mg/kg), SS-58-2 (32 mg/kg), and SS-100-2 (24 mg/kg). Pesticides were detected in 11 samples at a depth of five feet. Noteworthy is sample SS-73-5, which contained a total pesticide concentration of 302 mg/kg. Four samples contained pesticides at the ten-foot interval. Sample SS-76-10 contained the highest total pesticide level at 6 mg/kg.

The samples were also analyzed for TCL volatile and semi-volatile compounds. Table 12, Appendix A shows the results of these analyses.

For the Phase 4 investigation, sampling was conducted to further delineate the extent of contamination. During the Site investigation conducted in 1988, soil samples were collected near an old foundation located south of the Geigy property line. Previous use of the foundation site and its original purpose are unknown. The results of the study indicated isomers of BHC and toxaphene at a depth of 22 feet below ground surface.

Samples were collected near this foundation at the following depth intervals: 0-1 foot, 5-7 feet, 10-12 feet, 15-17 feet, and 20-22 feet. The analytical results are presented in Table 13, Appendix A. The surface sample contained the highest concentration of total pesticides. The Phase 4 sampling locations are shown in Figure 8.

To further define the horizontal extent of contamination, additional samples were collected. The sampling locations are shown in Figure 8 and the analytical results are given in Table 14, Appendix A. Sample SS-58-20S contained the highest concentration of total pesticides at 290 mg/kg. Other samples with noteworthy total pesticide concentrations include SS-61-20S (6 mg/kg), SS-62-20S (9 mg/kg), SS-63-20S (73 mg/kg), and SS-91-10N (32 mg/kg).

D. 1991 Removal

In accordance with an amendment to the Consent Order, the warehouse superstructures, pump house, and contaminated soils were removed from the Geigy Site during March and April of 1991. The removal limits were 500 mg/kg toxaphene and 100 mg/kg gamma-BHC. The excavated areas are shown on Figure 9 and the post-removal sampling results are shown in Table 15, Appendix A. A total of approximately 2000 tons of soil were removed from the Site.

E. Sediment Investigation

The sediment investigation was conducted in three phases. The first phase was performed to define the horizontal extent of contamination. The next phase included the collection of samples at one and two-foot depth intervals as well as samples downgradient of the first phase samples that contained significant concentrations of pesticides. The last phase consisted of samples collected at the two, five, and ten foot depth at locations exhibiting significant concentrations of pesticides in surface soils.

There are no surface water bodies on-site. The nearest perennial surface water body is Aberdeen Creek located approximately 4,000 - 5,000 feet west of the Site. The ditches convey stormwater runoff from the highway, railroad, and the Site, and are normally dry.

The first phase sediment samples were collected from the ground surface to a maximum depth of one-foot. Sample OSD-28 was collected from the surface to a depth of 1.5 feet and sample OSD-29 was collected from the same location at a depth of 1.5 to 3 feet. The increased depth sampling was due to the presence of sediments deposited at these locations. All sediment samples are shown in Figure 10.

Analytical results are given in Table 16, Appendix A. The same pesticides that were found in the soil samples were also found in the sediment samples, namely, the BHC isomers, the DDT isomers and toxaphene. Samples that contained noteworthy amounts of total pesticides include SD-1 (36 mg/kg), SD2 (14 mg/kg), SD-3 (21 mg/kg), SD-6 (50 mg/kg), SD-8 (17 mg/kg), SD-13 (23 mg/kg), SD-19 (19 mg/kg), SD-20 (16 mg/kg), SD-21 (17 mg/kg), OSD-24 (72 mg/kg), OSD27 (77 mg/kg), OSD-28 (30 mg/kg), and OSD-29 (55 mg/kg). Toxaphene concentrations ranged from not detected to 400,000 ug/kg. Also noteworthy is the concentration of DDT in Sample OSD-24 at 44,000 ug/kg and in sample OSD-27 at 52,000 ug/kg.

Sample results for the next phase of the sediments investigation are presented in Table 17,

Appendix A. These samples, taken down to a depth of 2.5 feet, still contained contaminants. Samples that contained noteworthy amounts of total pesticides include SD-1-1.5 (12 mg/kg), SD-6-1.5 (64 mg/kg), SD-9-2.5 (144 mg/kg), SD-11-1.5 (76 mg/kg), SD-11-2.5 (16 mg/kg), SD -12-1.5 (71 mg/kg), SD-12-2.5 (15 mg/kg), SD-21-1.5 (30 mg/kg), OSD-27-1.5 (29 mg/kg), OSD-27-2.5 (7 mg/kg), OSD-28-5 (5 mg/kg), and OSD-43-0.5 (52 mg/kg).

In the final phase, two, five, and ten foot samples were collected from four sample locations SD-10, SD-11, SD-12 and SD-14. These sample locations exhibited surface pesticide concentrations greater than 500 mg/kg prior to the 1991 removal.

Total pesticide concentrations on the whole, were lower than the shallow samples. Sample locations 12 and 14 showed significant amounts of contamination (Table 18, Appendix A).

VI. SUMMARY OF SITE RISKS

The Geigy Site is releasing contaminants into the environment. The Baseline Risk Assessment Report presents the results of a comprehensive risk assessment that addresses the potential threats to public health and the environment posed by the Site under current and future conditions assuming that no remedial actions take place and that no restrictions are placed on future use of the Site.

The Baseline Risk Assessment report consists of the following sections: identification of chemicals of potential concern; toxicity assessment; human exposure assessment, risk characterization; and environmental assessment. All sections are summarized below.

A. Contaminants of Concern

Data collected during the RI were reviewed and evaluated to determine the contaminants of concern at the Site which are most likely to pose risks to public health. These contaminants were chosen for each environmental media sampled.

Once these contaminants of concern were identified, exposure concentrations in each media were estimated. The maximum concentrations detected were compared to the calculated 95% confidence level of the arithmetic average of all samples, and the lower of these values was chosen as the estimated exposure concentration. Table 6-1 identifies the contaminants of concern and the reasonable maximum exposure (RME) concentration in each media sampled which was analyzed in the risk assessment.

B. Exposure Assessment

The exposure assessment identified potential pathways and routes for contaminants of concern. Two overall exposure conditions were evaluated. The first was the current land use condition, which considers the site as it currently exists. The second was the future land use condition, which evaluates potential risks that may be associated with any probable change in site use assuming no remedial action occurs.

The exposure pathways that were evaluated under current land use conditions were:

- Incidental ingestion of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Dermal absorption of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by a merchant north of the site,
- Inhalation of volatilized surface soil sediment chemicals by a nearby child resident (1-6 years) and a nearby adult resident northeast of the site,

- Inhalation of chemicals in wind blown dust particles by a nearby child resident (1-6 years) and a nearby adult resident northeast of the site.

- Inhalation of chemicals in wind blown dust particles by a nearby merchant north of the site.

The exposure pathways that were evaluated under future land use conditions were:

- Incidental ingestion of on-site surface soils/sediment by future on-site adult and child (1-6 years) residents and by a future on-site merchant,

- Dermal absorption of chemicals absorbed to surface soils/sediments by future on-site adult and child (1-6 years) residents and by a future on-site merchant,

- Ingestion of groundwater by future on-site adult and child (1-6 years) residents and by a future on-site merchant,

- Inhalation of volatile organic chemicals while showering with groundwater by a future on-site adult and child (1-6 years) residents,

- Dermal absorption of chemicals while showering with groundwater by future on-site adult and child (1-6 years) residents, and

- Inhalation of volatilized surface soil/sediment chemicals by future on-site adult and child (1-6 years) residents, and by future on-site merchants.

For ingestion of soil, an exposure frequency of 170 days/yr for residents and 120 days/yr for merchants was assumed. (A merchant is assumed to work 5 days/wk, 50 wks/yr (2 weeks subtracted for vacation), minus 9 days for federal holidays and is to spend half of that time outside. Values for adult and child residents are based on 5 days/wk during the warmer months, April through October, and 1 day/wk during November through March). The exposure duration used was 6 years for a child, 30 years for an adult, and 25 years for a merchant.

For ingestion of groundwater, an exposure frequency of 350 days/yr for residents and 241 days/yr for merchants was assumed. An ingestion rate of one liter per day was used for a child resident and an adult merchant. An ingestion rate of two liters per day was used for an adult resident.

C. Toxicity Assessment

Under current EPA guidelines, the likelihood of adverse effects to occur in humans from carcinogens and noncarcinogens are considered separately. These are discussed below. Table 6-2 summarizes the toxicity criteria for the contaminants of concern.

Carcinogens

EPA uses a weight of evidence system to classify a chemical's potential to cause cancer in humans. All evaluated chemicals fall into one of the following categories: Class A - Known human carcinogen; Class B - probable human carcinogen, B1 means there is limited human epidemiological evidence and B2 means there is sufficient evidence in animals and inadequate or no evidence in humans; Class C - Possible human carcinogen; Class D - Not classifiable as to human carcinogenicity; and Class E - Evidence of noncarcinogenicity for humans.

Cancer slope factors have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Slope factors, which are expressed in units of (kg-day/mg), are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upperbound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal -to-human extrapolation and uncertainty factors have been applied.

Noncarcinogens

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals

exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

D. Risk Characterization

To quantitatively assess the risks from the Geigy Site, the chronic daily intakes (CDI) were combined with the health effects criteria. For potential carcinogens, excess lifetime upperbound cancer risks were obtained by multiplying the estimated CDI for each chemical by its cancer slope factor. The total upperbound excess lifetime cancer risk for each pathway was obtained by summing the chemical-specific risk estimates. A cancer risk level of 1 x 10[-6] represents an upper bound probability of one in one million that an individual could develop cancer due to exposure to the potential carcinogen under the specified exposure conditions. Significant contributors to the exceedance of the cancer risk levels were toxaphene, dieldrin, and DDT.

Potential risks for noncarcinogens are presented as the ratio of the CDI to the reference dose for each chemical. The sum of the ratios of all chemicals under consideration is called the hazard index. The hazard index is useful as a reference point for gauging the potential effects of environmental exposures to complex mixtures. In general, a hazard index value greater than 1.0 indicates that the potential exists for adverse health effects to occur from the assumed exposure pathways and durations, and that remedial action may be warranted for the site. Significant contributors to the exceedance of 1.0 for the HI were barium, manganese, mercury, vanadium, and zinc.

Tables 6-3 and 6-4 summarize the quantitative estimates of risk under the current and future land use scenario for each target population respectively.

Currently, the site is vacant, and a current consumer of contaminated ground water from the site has not been identified. The total cancer risks for current land use ranged from 1E-06 to 9E-08. For future land use, it was assumed that the site would be used for residential purposes. The total cancer risks were in the 1E-03 range. For non-cancer risk, the baseline of 1 for the HI was exceeded for ingestion of surficial groundwater.

E. Environmental (Ecological) Risk

The vegetative community at the site is dominated by native grasses, which were planted following a previous removal action. Other herbaceous species which occur infrequently and along the perimeter of the site include poison ivy, cinquefoil, honeysuckle, passionflower, great ragweed, and goldenrod. A stand of bamboo occurs in the northeast corner of the site and a small number of pine trees occur in the eastern and western portions of the site. Terrestrial plants may be exposed to chemicals of concern in soil as a result of direct contact with subsequent plant uptake via the roots. No data are available on the toxicity of the chlorinated insecticides of concern on natural vegetation. The data that are available suggest that phytotoxic effects are likely to occur only at very high soil concentrations.

The site is not expected to support extensive wildlife populations, given its small size, the limited diversity of the vegetative community, and the availability of higher quality habitat in adjacent areas. Resident vertebrate species of the site are likely limited to small mammals such as voles and other field mice. Some snakes and lizards also could occur at the site. Other wildlife species could occasionally use the site while foraging.

Terrestrial wildlife exposures via the ingestion of food that has accumulated pesticides from the site are not likely to be significant. None of the chemicals of potential concern accumulate extensively in vegetation and therefore, significant exposure in the herbivorous species that may inhabit the site is unlikely. Some accumulation in soil invertebrates is possible and therefore animals that feed on these organisms could be exposed to chemicals in the food. The degree to which chemicals in soils at the site could be bioaccumulated is unknown.

Red-cockaded woodpeckers (a State and federal listed endangered species) which live in colonies located within one mile of the site are unlikely to be affected by chemicals in soil at the site. These woodpeckers feed on insects in trees, and generally do not feed below the understory layer.

F. Soil Remediation

Table 6-4 shows the estimated upperbound total carcinogenic risk posed by soil contaminants under a future residential exposure scenario. The calculated risk level of 3 x 10[-5] is based on soils contaminated at the level of the site-wide average being ingested by a child. (The site-wide soil data was used to develop a reasonable maximum exposure (RME) which is the 95% upper confidence limit of the samples arithematic average).

The future residential risk could have been calculated based on an assumption that a residence was placed at the site of the highest contaminant concentration detected (sample SS-06) in the sampling program. The assumption in this case would be that a child was constantly exposed to this higher value. This assumption gives an estimated upperbound risk of (4.4 x 10[-4]).

Soil Cleanup levels have been calculated at the 10[-6] risk level based on direct exposure residential assumptions. The health-based soil cleanup levels are identified in Table 6-5. Table 6-5 also indicates the maximum concentration of each contaminant found at the site.

VII. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with requirements or standards set forth under Federal and State environmental laws. The requirements that must be complied with are those that are applicable or relevant and appropriate to the (1) potential remedial actions, (2) location, and (3) media-specific chemicals at the Site.

This Section examines the cleanup criteria associated with the contaminants found and the environmental media contaminated.

A. Action-Specific ARARs

Action-specific requirements set controls or restrictions on the design, performance, and other aspects of implementation of specific remedial activities. Because action-specific ARARs apply to discrete remedial activities, their evaluation will be discussed in greater detail in Section VIII. A retained alternative must conform to all ARARs unless a statutory waiver is involved.

B. Location-Specific ARARs

Location-specific ARARs must consider Federal, State, and local requirements that reflect the physiographical and environmental characteristics of the Site or the immediate area. Remedial actions may be restricted or precluded depending on the location characteristics of the site and the resulting requirement. A listing of potential location-specific ARARs and their consideration towards the Site is given in Table 7-1

Federal classification guidelines for groundwater are as follows:

- Class I: Groundwater that is irreplaceable with no alternative source or is ecologically vital;

- Class II: A - Groundwater currently used for drinking water; B - Groundwater potentially available for drinking water;

- Class III: Groundwater not considered a potential source of drinking water due to natural contamination or insufficient yield.

The uppermost aquifer at the Site is considered Class IIB and the second uppermost aquifer is considered Class IIA. State classification guidelines are based on best usage (NCAC 2L.0201).

The uppermost and second uppermost aquifers are therefore considered Class GA groundwater under the State system.

C. Chemical-Specific ARARs

Chemical-specific ARARs are concentration limits in the environment promulgated by government agencies. Health-based site-specific levels must be developed for chemicals or media where such limits do not exist and there is a concern with their potential health or environmental impacts. Potential chemical-specific ARARs are shown in Table 7-3 and are discussed by media below.

Groundwater

Groundwater ARARs will be evaluated with respect to the uppermost and second uppermost aquifers at the Site. Potential ARARs for groundwater include Maximum Contaminant Levels (MCLs), North Carolina Drinking Water Standards, and North Carolina Groundwater Standards.

Maximum Contaminant Levels (MCLs)

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that MCLs, established under the Safe Drinking Water Act (SDWA), are potentially relevant and appropriate groundwater standards for groundwater that is a current or potential source of drinking water (40 CFR S 300.430 (e)(2)(i)(A)). The groundwater in the uppermost aquifer is a potential source of drinking water and the groundwater in the second uppermost aquifer is a current source of drinking water, therefore, MCLs will be considered the primary remediation goal. MCLs and proposed MCLs are provided in Table 74. In addition, the table presents the maximum groundwater concentration for a particular chemical and its associated sampling location as determined by the RI.

North Carolina Drinking Water and Groundwater Standards

North Carolina drinking water standards are essentially identical to the SDWA MCLs established by the EPA (Table 7-4). North Carolina Groundwater Standards (North Carolina Administrative Code (NCAC) Title 15A, Chapter 2, Subchapter 2L) are for Class GA groundwater, best usage as a source of drinking water. As seen in Table 7-4, the North Carolina Groundwater Standards for gammaBHC and toxaphene are below the CERCLA Contract Required Quantitation Limit (CRQL). The CRQL is the chemical-specific level that a laboratory must be able to routinely and reliably detect and quantitate in a specified sample. In such cases, the North Carolina Groundwater Standard defers to the quantitation limit as the maximum allowable concentration (15 NCAC 2L Section .0202(b)). In addition to the listed standards, Section .0202(c) specifies that substances which are not naturally occurring and for which no standard is specified shall not be permitted in detectable concentrations. Therefore, since pesticides are considered man-made and not naturally occurring, the North Carolina Groundwater Standard is the quantitation limit.

Concentrations are given in ug/l

SDWA MCL - Safe Drinking Water Act Maximum Contaminant Level
North Carolina DWS - NC Drinking Water Standards
North Carolina GWQS - NC Groundwater Quality Standards
CRQL - Contract Required Quanititation Limit

MCL for Gamma-BHC currently is 4 ug/l, New MCL (0.2) effective July 30, 1992

NA - Not Available

Groundwater remediation levels are provided in Table 7-5.

Soils

There are no promulgated Federal or State standards applicable for contaminants in soils at the Site.

CRQL - Contract Required Quanititation Limit
NCGWQS - North Carolina Groundwater Quality Standards

ND - Not Determined, Toxicity data unavailable, risk levels could not be calculated.

VIII. DESCRIPTION OF ALTERNATIVES

Tables 8-1 and 8-2 summarize the technologies considered for remediating the groundwater and soil contamination, respectively, at the Geigy Site. These tables also provide the rationale as to why certain technologies were not retained for further consideration after the initial screening.

A. Remedial Alternatives to Address Groundwater Contamination

The following alternatives were developed to address groundwater contamination at the site:

Alternative 1A: No Action

Alternative 1B: Long-term Monitoring of Site Groundwater

Alternative 2: Slurry Wall and Cap

Alternative 3: Groundwater Pump and Treat to Attain Remediation Levels

The remedial response actions to address groundwater contamination are discussed below.

Alternative 1A: No Action

No activities would be conducted on Site groundwater under this alternative. Existing monitoring wells would be retained as is for potential use, although no groundwater monitoring is included under this alternative. This alternative represents a true no action alternative. A review of remedy would be conducted every five years.

This alternative involves no capital costs. Operating costs are based on the review of Site conditions every five years. There would be no maintenance costs.

Total Construction Costs -	$ 0
Present Worth O & M Costs -	$140,000
Total Present Worth Costs -	$140,000

Alternative 1B: Long-term Monitoring of Groundwater

This alternative involves long-term monitoring of groundwater. Four additional monitoring wells would be constructed in the second uppermost aquifer. Sampling would be twice a year with analyses for pesticides in the uppermost aquifer and pesticides and TCE in the second uppermost aquifer. Deed restrictions on future uses of the property would also be included. Since wastes would remain at the Site, a review of this alternative would be conducted every five years as required by SARA.

Capital costs include the construction of four additional monitoring wells. Operating costs include periodic sampling of selected monitoring wells, chemical analyses, reporting and review of the Site conditions every five years. Monitoring costs are based on a period of 30 years. Maintenance costs would include inspection of the monitoring wells.

Total Construction Costs -	$ 130,000
Present Worth O & M Costs -	$1,500,000
Total Present Worth Costs -	$1,630,000

TABLE 8-1
GROUNDWATER REMEDIATION TECHNOLOGIES CONSIDERED

TECHNOLOGY	STATUS	REASON
GROUNDWATER RECOVERY		
Extraction Well	Retained	
Interception Trenches/ Subsurface Drains	Retained	
No Action	Retained	
GROUNDWATER TREATMENT		
Air Stripping	Rejected	Effectiveness
Activated Carbon Adsorption	Retained	
Sorptive Resins	Rejected	Effectiveness/ Reliability
Chemical Oxidation (UV-Ozone)	Retained	
Biological Treatment	Rejected	Effectiveness
Land Treatment	Rejected	Effectiveness
GROUNDWATER DISCHARGE		
Horizontal Infiltration Gallery	Retained	Provisionally Depending on Application Rates
Injection Wells	Rejected	Not permittable
Surface Water Discharge	Rejected	Not cost effective
POTW	Retained	
GROUNDWATER CONTAINMENT		
Slurry Wall, Capping and Well Point Extraction	Retained	

TABLE 8-2
SOIL REMEDIATION TECHNOLOGIES CONSIDERED

TECHNOLOGY	STATUS	REASON/NOTES
DIRECT TREATMENT		
Land Treatment	Rejected	Effectiveness
Bioreactor	Rejected	Effectiveness/ Implementability
Supercritical CO2 Extraction	Rejected	Not a Demonstrated Technology
Critical Fluid Solvent Extraction	Rejected	Not a Demonstrated Technology
Best Process	Rejected	Not a Demonstrated Technology
Supercritical Water Oxidation	Rejected	Not a Demonstrated Technology
Soil Washing	Rejected	Not Demonstrated Under Similar Site
Conditions/Implementation		
Stabilization/Solidification	Rejected	Effectiveness
Transportable Incineration	Retained	Soil Only
Thermal Desorption	Retained	Soil Only
Classification	Retained	Treatability Testing Required
IN-SITU TREATMENT		
Soil Vapor Extraction	Rejected	Effectiveness
Enhanced Biodegradation	Rejected	Effectiveness
Soil Flushing	Rejected	Effectiveness
Vitrification	Rejected	Not Fully Developed
OFF-SITE TREATMENT		
Commercial Landfilling	Retained	Soil and Foundation Debris
Commercial Incineration	Retained	Soil Only
CONTAINMENT		
Capping	Retained	Soil and Foundation Debris
On-Site Landfill	Rejected	Implementation
No Action	Retained	Soil and Foundation Debris

Alternative 2 - Slurry Wall and Cap

This alternative would involve construction of an interconnected slurry wall and cap system to contain Site groundwater. The slurry wall would be keyed into the uppermost aquitard. The cap would prevent infiltration from entering the slurry wall enclosure and creating an outward hydraulic gradient. Extraction wells would be located outside of the slurry wall in the uppermost and second uppermost aquifer.

Slurry wall construction would involve excavating a trench under slurry to depths ranging from 45 to 70 feet. Excavations to these depths approaches the limits of technical feasibility and would require special excavation equipment with extended reach capability. Permeability of the slurry wall would be 1E-07 cm/sec. The slurry wall could be constructed using the bio-polymer method, however, actual construction methods would be determined during the Remedial Design. The length of the circumferential slurry wall would be approximately 40 to 70 feet. Width of the slurry wall would be approximately three feet.

A low permeability cap would be constructed above the perimeter of the slurry wall to minimize infiltration within the slurry wall. The cap would consist of a compacted sub-base of common and select fill, 60-mil HDPE liner, drainage net, filter fabric, soil cover and vegetation. Permeability of the cap would be approximately 1 x 10[-13] cm/s. The area of the cap would be approximately 3 acres. The cap would be tied into the slurry wall to form an integral unit. Drainage swales would be constructed along the cap perimeter to control surface run-on and direct cap run-off. A security fence would be constructed along the perimeter of the cap to deter unauthorized access.

Groundwater recovery within the slurry wall would be accomplished using well point extraction. Groundwater recovery would be necessary to maintain a hydraulic differential across the slurry wall which would restrict groundwater migration outward from the slurry wall. The slurry wall would have no effect upon groundwater in the second uppermost aquifer. Groundwater recovery would be implemented outside of the cap/slurry wall system for groundwater exceeding the remediation levels using groundwater extraction. One recovery well would be placed in the uppermost aquifer and two recovery wells would be placed in the second uppermost aquifer. Treatment of contaminants would be by carbon adsorption. Disposal options for the treated groundwater are the POTW and an on-site infiltration gallery. Actual disposal requirements would be determined during the RD.

Since compound residuals would remain, review of the effectiveness and protectiveness of this alternative every five years would be required by SARA.

Total Construction Costs -	$ 8,400,000
Present Worth O & M Costs -	$ 1,800,000
Total Present Worth Costs -	$10,200,000

Alternative 3 - Groundwater Recovery to Attain Remediation Levels

This alternative involves the recovery of groundwater such that the remediation levels would be attained. Contamination would be removed through extraction wells placed in the uppermost and second uppermost aquifers and reduced through treatment by activated carbon. Discharge of the treated water would be either to the Moore County POTW or to an on-site infiltration gallery.

The proposed extraction system would involve the installation of approximately nine recovery wells; seven in the uppermost aquifer and two in the second uppermost aquifer.

Carbon adsorption is considered to be the best available technology for the removal of pesticides from water. The treatment system would involve two carbon adsorption canisters in series, to maximize carbon usage and provide protection against breakthrough. A standard canister would be expected to last approximately two years. Spent carbon would only be sent to a RCRA TSD facility in full compliance with its Part B permit, in accordance with EPA's off-site policy.

Discharge of the treated groundwater would be to the Moore County POTW or to an on-site infiltration gallery. Discharge to the POTW would require construction of a force main to the nearest manhole, approximately 1/2 mile away. Construction requirements for an infiltration gallery are based on a nominal application rate of 0.5 gpd/ft[2]. The actual method of discharge and operating parameters would be established during RD.

Further characterization will be conducted in the second uppermost aquifer to determine the extent of pesticide contamination and to attempt to determine the source and extent of TCE contamination. If the source of the TCE cannot be determined, it will be assumed that the TCE is site-related. This characterization will be conducted during the pre-design activities associated with groundwater remediation. To achieve this, the installation of four additional groundwater monitoring wells in the second uppermost aquifer is included in the cost estimate. Actual requirements would be established during the RD.

Costs for this alternative are based on discharge to the POTW, which would have both higher construction and operating costs than discharge to an infiltration gallery. Costs are based on a remediation period of thirty years.

Total Construction Costs -	$ 710,000
Present Worth O & M Costs -	$1,500,000
Total Present Worth Costs -	$2,210,000

B. Remedial Alternatives to Address Soil Remediation

The response actions to address soil remediation are:

Alternative 1 - No Action

Alternative 2 - Off-Site Disposal

Alternative 3 - Capping

Alternative 4 - On-Site Thermal Desorption

Alternative 5 - On-Site Incineration

Each of the soil remediation alternatives is described below.

Alternative 1 - No Action

In this alternative, no soil remedial activities would occur. There are no construction costs. Operating costs would involve a review of the remedy every five years.

Total Construction Costs -	$ 0
Present Worth O & M Costs -	$140,000
Total Present Worth Costs -	$140,000

Alternative 2 - Off-Site Disposal

This alternative would involve the excavation and off-site disposal of the top foot of soils exceeding the remediation levels. Soils would be taken to either a secure landfill or a fixed-based incinerator, depending on their regulatory disposition. Composite samples would be collected from stockpiles and analyzed by the TCLP. The entire stockpile would then be disposed according to its composite TCLP analysis. Soils failing the toxicity characteristic leaching procedure (TCLP) test would be considered hazardous by characteristic and incinerated to satisfy land disposal restrictions (LDR). Soils passing the TCLP would be sent to a RCRA-approved landfill.

Confirmation sampling would be conducted to ensure that remediation levels are attained. Excavated areas would then be covered with clean fill and vegetated with a perennial grass.

This alternative would also involve the demolition of the building foundation. Concrete debris should be acceptable for disposal at a municipal landfill. Actual disposal requirements would be determined during Remedial Design following confirmation testing. Implementation time would depend on the number of crews involved but should be approximately three months.

Construction costs associated with this alternative include mobilization, excavation, earth work, disposal (landfill and/or incineration), material and labor. There would be no operating costs. To provide the greatest allowance for potential remediation costs, it was assumed that all soils (approximately 1000 cubic yards) went either to a secure landfill (lowest cost) or to an incinerator (highest cost). The greatest likelihood is that a portion of the soils would fail TCLP and be sent to an incinerator while the remainder would be sent to a secure landfill. By presenting the costs of both extremes, the actual remedial costs would likely fall somewhere in the range. Demolition of the building foundation and disposal at a municipal landfill is included within both ends of the estimate.

	Landfilling	Incineration
Total Construction Costs -	$600,000	$2,440,000
Present Worth O & M Costs -	$ 0	0
Total Present Worth Costs -	$600,000	$2,440,000

Alternative 3 - Capping

This alternative involves construction and operation of an engineered cover to deny human access to those Site soils exceeding the remediation levels. The cap would be constructed of a non-woven polypropylene geomembrane impregnated and sealed with an asphalt overlay. This design would have long -term durability with a minimal amount of maintenance. Drainage swales would be constructed along the cap perimeter to control surface run-on and direct cap run-off. A security fence would be constructed along the perimeter of the cap to deter unauthorized access. Deed restrictions would be included in the implementation of this alternative as a secondary control measure to prevent uses of the Site that could reduce the effectiveness of the remedial measures.

Periodic inspections would be required to check for erosion, settling, and conditions of the drainage system. An established inspection and maintenance schedule would be implemented following construction and continued for as long as chemical residuals remained at the Site. Demolition of the building foundation would be required under this alternative to gain access to some of the underlying soils. Disposal of the foundation debris would be at a municipal landfill. Implementation time would depend on the number of crews involved but should be approximately two months.

Construction costs associated with this alternative include mobilization, excavation, grading, earth work, materials, labor, demolition and disposal. Operating costs include maintenance of the cap and review of the Site remedy every five years. Maintenance costs include periodic inspections and grounds keeping.

Total Construction Costs -	$ 95,000
Present Worth O & M Costs -	$180,000
Total Present Worth Costs -	$275,000

Alternative 4 - On-Site Thermal Desorption

In this alternative, soils exceeding the remediation levels would be excavated and treated utilizing low temperature thermal technology. The treated soil will be returned to its original location.

The low temperature thermal treatment will volatilize the organic contaminants at a temperature generally less than 1000 degrees F. The off-gases will be captured and treated to prevent the release of contaminants into the environment. Treatment of the soils will continue until remediation levels are attained and the soil can pass the TCLP test for toxaphene and gamma-BHC. Demoltion and disposal of the building foundation would be required to gain access to underlying soils.

The treatment selected to treat Off-gases will vary with the vendor selected, but will normally consists of one of the following systems: (1) thermal oxidation in a secondary thermal oxidation chamber similar to incinerators; or (2) condensing and concentrating the organics into a significantly smaller mass for further treatment (incineration); or (3) passing the off-gasesthrough activated carbon to adsorb in the contaminants and then regenerating the carbon. For cost estimation purposes, the last treatment option (carbon adsorption) was used.

The volume of contaminated soil is below what the Agency feels is a sufficient amount of contaminated soil to attract the interest of qualified vendors to implement an on-site remedy. However, to provide a cost comparison with the other alternatives the following assumptions were made and a probable cost derived. The estimated amount of soil to be treated is low (approximately 1,000 cubic yards), the treatment unit utilized would probably be small; the magnitude of a pilot-scale operation. Assuming a process rate of 2.5 tons per hour, the actual treatment time is estimated to be approximately one month. The planning, materials screening and handling will require a approximately four to six additional months. This alternative may also require implementation of a treatability study, which would add an additional twelve months to the estimated time to implement this alternative. Implementation time for this alternative will be approximately two years, with a total cost as shown below.

Total Construction Costs -	$700,000
Present Worth O & M Costs -	$ 0
Total Present Worth Costs -	$700,000

Alternative 5 - On-Site Incineration

Incineration is a thermal treatment technology which utilizes elevated temperatures to destroy or detoxify hazardous waste. Under this alternative, contaminated soil and debris would be incinerated on-site. Residual ash from the incinerator would be redeposited on-site and covered with clean fill. The ash would have to pass the TCLP before depositing to ensure that the ash is non-hazardous.

Incineration is considered the Best Demonstrated Available Technology (BDAT) for halogenated organic compounds, which includes most of thepesticides found at the Site. The contaminated soil will be excavated, homogenized and sized, incinerated, tested, and disposed back on-site. Any process wastewater or scrubber blowdown sludge will be treated by reinjection into the incinerator.

The incinerator and air pollution control unit will be operated so that:

An operating temperature in the kiln of 1,800 degrees F is maintained at all times to ensure that any volatile and semi-volatile organic constituents in the waste stream are driven out of the ash and that the fixed carbon remaining in the ash is minimized;

An operating temperature in the afterburner of 2,000 degrees F is maintained at all times to oxidize and destroy all remaining organic substances prior to exiting the afterburner and entering the pollution control system;

The incinerator must achieve a destruction and removal efficiency (DRE) of 99.99% for all designated principal organic hazardous constituents (POHC); and

The air pollution control system will achieve performance standards of (1) hydrogen chloride of less than 4 lb/hr and (2) particulate matter of less than 0.08 grains per day ft[3] in the exhaust gas corrected oxygen content.

Because this is considered an "on-site" CERCLA response action, no state, local, or federal permits are necessary. Operation of the incineration unit will be in compliance with RCRA regulations.

Demolition and disposal of the building foundation would be required to gain access to underlying soils.

On-site incineration is similar to on-site thermal desorption with regard to practicality of implementation for such a small amount of soil. For those reasons on-site incineration is not considered a viable alternative. For sake of cost comparison, several assumptions were made and a relative cost was derived for this option, which is shown below.

Total Construction Cost -	$1,327,100
Present Worth O & M Cost -	$ 0
Total Present Worth Cost -	$1,327,100

IX. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives to address groundwater and soil contamination were evaluated using the nine evaluation criteria as set forth in the NCP, 40 CFR S 300.430 (e)(9). A brief description of each of the nine evaluation criteria is provided below.

THRESHOLD CRITERIA

1. Overall Protection of Human Health and the Environment addresses how an alternative as a whole will protect human health and the environment. This includes an assessment of how the public health and the environment risks are properly eliminated, reduced, or controlled through treatment, engineering controls, or controls placed on the property to restrict access and (future) development. Deed restrictions are examples of controls to restrict development.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether or not a remedy complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup options at a specific site. If an ARAR cannot be met, the analysis of the alternative must provide the grounds for invoking a statutory waiver.

PRIMARY BALANCING CRITERIA

3. Long-term Effectiveness and Permanence refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the cleanup goals have been met.

4. Reduction of Toxicity, Mobility, or Volume are the three principal measures of the overall performance of an alternative. The 1986 amendments to the Superfund statute emphasize that, whenever possible, EPA should select a remedy that uses a treatment process to permanently reduce the level of toxicity of contaminants at the site; the spread of contaminants away from the source of contaminants; and the volume, or amount, of contamination at the site.

5. Short-term Effectiveness refers to the likelihood of adverse impacts on human health or the environment that may be posed during the construction and implementation of an alternative until cleanup goals are achieved.

6. Implementability refers to the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the alternative.

7. Cost includes the capital (up-front) cost of implementing an alternative, as well as the cost of operating and maintaining the alternative over the long-term, and the net present worth of both the capital and operation and maintenance costs.

MODIFYING CRITERIA

8. State Acceptance addresses whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comments on the alternative EPA is proposing as the remedy for the Site.

9. Community Acceptance addresses whether the public concurs with EPA's proposed plan. Community acceptance of this proposed plan will be evaluated based on comments received at the public meetings and during the public comment period.

These evaluation criteria relate directly to requirements in Section 121 of CERCLA 42 USC Section 9621, which determine the overall feasibility and acceptability of the remedy. Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. State and community acceptance are modifying criteria formally taken into account after public comment is received on the proposed plan. Table 9-1 provides a summary of all the alternatives along with the total present worth costs. The evaluation of the potential remedial alternatives to address soil and groundwater were developed as follows.

A. Ground Water Remediation

The following alternatives were subjected to detailed analysis for groundwater remediation:

Alternative 1A: No Action

Alternative 1B: Long-term Monitoring of Groundwater

Alternative 2: Slurry Wall and Cap

Alternative 3: Groundwater Recovery and Treatment to Attain Remediation Levels

TABLE 9-1
REMEDIAL ALTERNATIVES SUMMARY

GROUNDWATER	REMEDIAL ACTION	TOTAL PRESENT WORTH COSTS
Alternative 1A	No Action	$140,000
Alternative 1B	Long-term Monitoring of Groundwater	$1,630,000
Alternative 2	Slurry Wall and Cap	$10,200,000
Alternative 3	Groundwater Extraction for Remediation Levels; Carbon Adsorption; Discharge to POTW	$2,210,000
SOIL		
Alternative 1	No Action	$140,000
Alternative 2	Off-Site Disposal	
	Total Landfilling	$600,000
	Total Incineration	$2,440,000
Alternative 3	Capping	$275,000
Alternative 4	On-Site Thermal Desorption	$700,000
Alternative 5	On-Site Incineration	$1,327,100

Overall Protection of Human Health and the Environment

Groundwater poses no risks to human health under current conditions. Under the future use condition the no action alternative would not address pesticide levels in groundwater and therefore would not be protective of human health. Alternative 2 would attain the remediation goals by containing groundwater in the uppermost aquifer and recovering groundwater in the second uppermost aquifer. Alternative 3 would attain the remediation goals by recovering groundwater in the uppermost and second uppermost aquifer. Therefore, Alternatives 2 and 3 would be protective of human health and the environment.

Compliance With ARARs

The no action alternative would not comply with ARARs. Alternative 2 would attain remediation levels outside of the slurry wall in the second uppermost aquifer and prevent remediation levels from being exceeded off-site in the uppermost aquifer. Alternative 3 would attain remediation levels in both aquifers. The cap in Alternative 2 would be designed to conform to RCRA performance standards. Construction of the groundwater recovery, treatment and discharge systems for Alternatives 2 and 3 would satisfy action specific ARARs. Discharge to an on-site infiltration gallery would comply with the substantive aspects of a NC Non-Discharge Permit.

Long-term Effectiveness and Permanence

Pesticide levels would decrease permanently through recovery outside of the slurry wall for Alternative 2 and in both aquifers in Alternative 3. Construction of a slurry wall under Alternative 2 would be complicated by the depths to the uppermost aquitard (up to 70 feet). The competence of the resulting connection would be verified through hydraulic and analytical monitoring of groundwater. Carbon adsorption is considered Best Available Treatment for pesticides in groundwater. Alternative 2 would be a permanent installation that would require review and maintenance indefinitely. Alternative 3 would be discontinued once the remediation levels were achieved.

Reduction of Toxicity, Mobility, and Volume

Alternative 2 would reduce the mobility of pesticides in the uppermost aquifer through containment and reduce the volume of pesticides in the second uppermost aquifer through recovery. Alternative 3 would reduce the volume of pesticides in both aquifers through recovery and treatment and comply with the statutory preference for alternatives involving treatment.

Short-term Effectiveness

All of the alternatives can be implemented without significant risks to the community or on-site workers and without adverse environmental impacts. Construction schedules would be as follows: Alternative 1A - None; Alternative 1B - 1 month; Alternative 2 - 8 months; and Alternative 3 - 3 months. Construction of Alternative 2 could not proceed until the rail line was rerouted, a potentially significant obstacle on an institutional basis.

Implementability

Alternatives 1A, 1B, and 3 would not pose significant concerns regarding implementation. Construction of the slurry wall for Alternative 2 would approach the limits of technical feasibility due to the required depths (up to 70 feet). Design of the treatment system for Alternatives 2 and 3 could not be conducted until discharge requirements were defined.

Cost

Total present worth costs for the groundwater alternatives are presented in Table 29.

B. Soil Remediation

The following alternatives were developed for Site soils and were subjected to detailed analysis:

Alternative 1: No Action

Alternative 2: Off-Site Disposal

Alternative 3: Capping

Alternative 4: On-Site Thermal Desorption

Alternative 5: On-Site Incineration

A summary of the evaluation of these alternatives is presented below.

Overall Protection of Human Health and the Environment

Potential risks due to Site soils under current and potential future conditions (residential scenario) are within the acceptable range of risk specified by the National Contingency Plan (NCP).

Compliance with ARARs

There are no Federal or State ARARs for pesticides in soils. Alternative 2 would comply with EPA's off-site policy and applicable land disposal restrictions. Alternative 3, consolidation of Site soils and capping in place would not trigger any RCRA requirements. Alternatives 4 and 5 would comply with all applicable ARARs, including LDRs.

Long-term Effectiveness and Permanence

Alternative 1 would not be effective in reducing contaminant levels. Alternatives 2 and 4 would result in a permanent reduction in Site risks. Alternative 3 could be effective in the long term through regular maintenance of the cap, but a review of remedy would be required every five years since a cap is not considered a permanent remedy. Alternatives 4 and 5 would maintain reliable protection of human health and the environment over time once the remediation levels were achieved.

Reduction of Toxicity, Mobility, and Volume

Pesticide levels would remain unchanged for Alternative 1. Alternatives 2, 4 and 5 would reduce pesticide levels significantly. Alternative 3 would not reduce the volume, but would reduce the mobility and effective toxicity of the pesticides.

Short-term Effectiveness

All of the alternatives can be implemented without significant risks to on-site workers or the community and without adverse environmental impacts.

Implementability

No implementation is needed for the no action alternative. Offsite disposal to a RCRA-approved landfill and incinerator have been conducted successfully in the past at the Geigy Site. Construction of the cap would pose no significant difficulties. Alternatives 4 and 5 are implementable, however the low volume of contaminated soils requiring remediation renders these alternatives impractical at this site.

Cost

Total present worth costs for the soil remediation alternatives are presented in Table 9-1.

C. Modifying Criteria

State and community acceptance are modifying criteria that shall be considered in selecting the remedial action.

State Acceptance

The State of North Carolina concurs with the selected remedy.

Community Acceptance

A proposed plan fact sheet was released to the public on March 26, 1992. The proposed plan public meeting was held on March 31, 1992. The public comment period on the proposed plan was held from March 26, 1992 to May 25, 1992. The letters, comments, and questions asked during the March 31st meeting and received during the comment period are summarized in the attached Responsiveness Summary.

X. THE SELECTED REMEDY

Section 121 of CERCLA, as amended, 42 U.S.C. S 9621, and the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) establish a variety of requirements relating to the selection of the remedial action under CERCLA. Having applied the evaluation criteria to the groundwater and soil remediation alternatives, EPA has selected the following remedy for the Geigy Site.

Groundwater Remediation

Alternative 3 - Recovery and Treatment of all Site Groundwater exceeding Groundwater Remediation Levels using Carbon Adsorption

Soil Remediation

Alternative 2 - Off-site Disposal of Soils exceeding Soil Remediation Levels

A. Groundwater Remediation

The treatment technology selected for remediation of the contaminated groundwater shall consist of a groundwater extraction and treatment systems. An overall monitoring program shall be developed and implemented for the Site. Groundwater contaminated above the remediation levels indicated in Table 7-2 shall be extracted across the entire Site. Extraction will continue until the remediation levels are achieved

Actual design of the extraction system shall be established during the Remedial Design. For costing purposes, nine recovery wells (seven in the uppermost aquifer and two in the second uppermost aquifer) have been anticipated.

Treated ground water shall be discharged to the Moore County Publicly Owned Treatment Works (POTW) or an infiltration gallery. The treated groundwater shall meet Moore County POTW preliminary discharge requirements. Discharge to the POTW will require the construction of a force main to the nearest manhole, approximately 1/2 mile away. Actual discharge and operating parameters shall be established during the Remedial Design.

The treatment system shall involve at least two carbon adsorption canisters in series, to maximize carbon usage and provide protection against breakthrough. Breakthrough of the carbon will be monitored as part of the annual operation and maintenance requirements. The spent carbon shall be shipped offsite for destruction, disposal or reactivation. The most cost efficient option will be identified and selected. Actual treatment requirements shall be determined during the Remedial Design and will be dependent on the final discharge limits.

The conceptual flow diagram for groundwater treatment is presented in Figure 11. The groundwater treatment shall involve the following elements: Manifolding of the extraction well piping to the treatment system; concentration equalization; carbon adsorption canisters; transfer pumps; flow measurement and sampling; and discharge line to the Moore County POTW.

Construction of the extraction wells including well head equipment installation is estimated to take 1 to 1-1/2 months with minimal disruption of Highway 211 traffic.

Further characterization shall be conducted in the second uppermost aquifer to determine the extent of pesticide contamination and to determine the source and extent of trichloroethene contamination. For costing purposes, the installation of four additional groundwater monitoring wells in the second uppermost aquifer have been included. Actual monitoring requirements shall be established during the Remedial Design to determine if the trichloroethene is Site related. All site-related TCE shall be remediated through groundwater extraction and activated carbon treatment. Until it is proven otherwise TCE is considered a site related contaminant, and shall be treated as an contaminant of concern.

The goal of this remedial action is to restore groundwater to its beneficial use as a drinking water source. Based on information obtained during the RI and on a careful analysis of all remedial alternatives, EPA and the State of North Carolina believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the ground water extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation level over some portion of the contaminated plume. In such a case, the system performance standards and/or the remedy may be reevaluated.

The selected remedy will include groundwater extraction for an estimated period of 30 years, during which time the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation.

Modifications may include any or all of the following:

- alternating pumping at wells to eliminate stagnation points;

- pulse pumping to allow aquifer equilibration and to allow adsorbate contaminants to partition into groundwater;

- installation of additional extraction wells to facilitate or accelerate remediation of the contaminant plume; and

- at individual wells where remediation levels have been attained, and after analytical confirmation, pumping may be discontinued.

To ensure that remediation levels continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased initially every year following discontinuation of groundwater extraction. This monitoring will be incorporated into an overall Site monitoring program which will be fully delineated in the Operations and Maintenance portion of the Remedial Design.

If it is determined, on the basis of the preceding criteria and the system performance data, that certain portions of the aquifer cannot be restored to their beneficial use, all of the following measures involving longterm management may occur, for an indefinite period of time, as a modification of the existing system;

a) engineering controls such as physical barriers, or long-term gradient control provided by low level pumping, as containment measures;

b) chemical-specific ARARs will be waived for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further containment reduction;

c) institutional controls will be provided and maintained to restrict access to those portions of the aquifer which remain above health-based goals, since this aquifer is classified as a potential drinking water source;

d) continued monitoring of specified wells; and

e) periodic re-evaluation of remedial technologies for groundwater restoration.

The decision to invoke any or all of these measures may be made during a periodic review of the remedial action, which will occur at intervals of at least every five years, in accordance with CERCLA 121(c). To ensure State and public involvement in this decision at this Site, any changes from the remediation goals identified in this ROD will be formalized in either an Explanation of Significant Difference document or an Amendment to this Record of Decision, thereby providing an opportunity for State and public comment.

Soil Remediation

The treatment technology selected for remediation of pesticide contaminated soils at the Geigy Site is off-site disposal.

The top foot of soil exceeding the remediation levels in Table 6-5, shall be excavated and stock-piled on-site. Composite samples shall be collected from the stockpiles and analyzed using the toxicity characteristic leaching procedure (TCLP), and taken to either a secure landfill or a fixed-base incinerator, depending on their regulatory requirements. Soils failing the (TCLP) test shall be considered hazardous by characteristic and incinerated to satisfy land disposal restrictions (LDR). Soils passing the TCLP shall be sent to a RCRA-approved landfill.

Confirmation sampling shall be conducted to ensure that remediation levels are attained. Excavated areas shall then be covered with clean fill and vegetated with a perennial grass.

The building foundations shall be demolished and the concrete debris shall be disposed of at a municipal landfill. Actual disposal requirements shall be determined during Remedial Design following confirmation testing.

The Geigy Site shall have a fence and proper warning signs posted in visible locations in order to provide site control where humans have access to the release.

C. Performance Standards

Performance standards are defined as any applicable or relevant and appropriate standards/ requirements, cleanup goals and/or levels, or remediation goals and/or levels to be achieved by the remedial action. The performance levels to be attained by the Geigy remedial action are specified in the following tables:

Groundwater Remediation Levels	Table 7-5
Soil Remediation Levels	Table 6-5

All treatment and disposal of soils shall comply with applicable or relevant and appropriate requirements (ARARs). The design, construction and operation of the groundwater treatment system shall be conducted in accordance with all ARARs. See Section 7 for a list of potential ARARs.

D. Cost

The total present worth cost for the entire remedial action will range between $2,810,000 and $4,650,000.

XI. STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. S 9621, establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The selected remedy will permanently treat the groundwater and soil and remove or minimize the potential risk associated with the wastes. Dermal, ingestion, and inhalation contact with Site contaminants would be eliminated.

Compliance with ARARs

The selected remedy will comply with all Federal and State applicable or relevant and appropriate chemical-, location-, and action-specific requirements (ARARs).

Groundwater remediation levels (Table 7-2) would be met at the Site under this alternative. Discharge of groundwater to the POTW would comply with the MCSSA sewer use ordinance.

There are no Federal or State ARARs for pesticides in soils. The selected remedy will comply with all applicable ARARs, including LDRs.

Cost Effectiveness

The selected groundwater and soil remediation technologies are more cost-effective than the other acceptable alternatives considered. The selected remedies provide greater benefit for the cost because they permanently treat the waste.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment can be practicably utilized for this action. Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA and the State have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness, implementability, and cost; State and community acceptance, and the statutory preference for treatment as a principal element.

Preference for Treatment as a Principle Element

The preference for treatment is somewhat satisfied by the use of off-site disposal which encompasses incineration for the soils containing characteristic hazardous waste and land disposal for the residual soils at an approved RCRA landfill. Groundwater meets the treatment preference with the use of carbon adsorption to treat contaminated groundwater at the Site. The principal threats at the Site will be mitigated by use of these treatment technologies.

XII. Documentation of Significant Change

Based on comments received during the comment period, the Agency no longer believes the preferred alternative presented in the proposed plan (Alternative 4 - On-Site Thermal Desorption for soil) provides the most appropriate balance among the alternatives with respect to the nine evaluation criteria.

Information available to the Agency suggests that alternative 2, Off-site Disposal, presented in the proposed plan provides the best balance of trade-offs. The Agency has selected off-site disposal of the contaminated soil in conjunction with Groundwater Pump and Treat System as the final remedy.

More specifically, the practicality of on-site treatment at this site has been greatly reduced. The main reason for this is the reduction of soil requiring treatment. The originally estimated amount of 2,200 cubic yards of contaminated soil has been reduced to 1,000 cubic yards. This present volume of contaminated soil is below what the Agency feels is a sufficient amount of contaminated soil to attract the interest of qualified vendors to implement an onsite remedy.

The Agency's initial volume estimate of contaminated soil was the result of a conservative approach. The original estimate considered the risk to human health based on future excavation at the site that could bring contaminated subsurface soil to the surface and thereby cause adverse health or environmental effects by direct contact. Further evaluation of the data revealed that under any scenario the contamination in the subsurface soils posed no threat to human health or the environment when brought to the surface and distributed. This evaluation also revealed that excavation of surface soil to the depth of one foot would provide adequate protection of human health and the environment.

This remedy is in accord with the concerns expressed during the comment period by the affected community, responsible parties, and the State.

APPENDIX A